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# The mechanism for the enhanced conductivity in Al and/or V substituted $LiTi_2(PO_4)_3$

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$LiTi_2(PO_4)_3$ is one of the promising $Li^+$-conductive solid electrolytes and has been studied because of its potential use in all-solid-state lithium batteries. Although LTP shows relatively high chemical stability against ambient atmosphere, the application of LTP is limited due to its low conductivity at room temperature (~$10^{-7}$ $Scm^{-1}$). The conductivity of LTP was significantly improved by substituting Ti ion with trivalent ions such as Al, and the enhanced conductivity in substituted LTP was attributed to the improved densification. However, all the previous conductivity comparisons have been made in the specimens with different densities and the effect of substituting ions was not determined at similar density.

In this study, a spark plasma sintering (SPS) method was employed to improve the sinterability. Three kinds of fully dense specimens (~96%) (pure LTP, LATP ($Li_{1.3}Al_{0.3}Ti_{1.7}(PO_4)_3$), and LATPV ($Li_{1.3}Al_{0.3}Ti_{1.7}(PO_4)_{2.9}(VO_4)_{0.1}$)) were prepared by SPS and the conductivity was determined by impedance analyzer. At a similar level of densification, the conductivity of LATP and LATPV specimens was still higher than LTP suggesting that the enhanced conductivity is not only due to the improved densification. The other possible explanations will be discussed in this presentation.